Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
	)	
	)	
Unlicensed National Information Infrastructure (U-NII) Devices in the 5 GHz Band	)	ET Docket No. 13-49
	)	
	)	
	)	
	)	

COMMENTS OF MICROSOFT CORPORATION

Paula Boyd
Director of Government Relations and
Regulatory Affairs

Michael Daum
Technology Policy Strategist

Microsoft Corporation
901 K Street NW, 11th Floor
Washington, DC 20001

Of Counsel:

Lawrence R. Krevor
James F. Ianelli
Perkins Coie, LLP
700 13th Street, NW
Washington, DC 20005

TABLE OF CONTENTS

Page

SUMMARY…… ii
I. INTRODUCTION……... 1
II. DISCUSSION……... 4
A. The Commission Should Focus on DSRC Safety-of-Life Applications…... 4
B. Qualcomm Re-Channelization Proposal……....7
C. Cisco Detect and Avoid Proposal……..... 9
III. CONCLUSION……...10

SUMMARY

Microsoft supports U-NII devices sharing the 5.9 GHz band with DSRC operations on a secondary basis. Microsoft's customers, whether in an enterprise or as individual consumers, access its cloud-based services over unlicensed devices in the 2.4 GHz ISM band, and increasingly in the 5 GHz U-NII bands. The 2.4 GHz band is congested, and even the additional spectrum in the 5 GHz U-NII bands is becoming saturated at certain times and places as the demand for mobile data grows unabated. Given that the majority of mobile data is delivered to user equipment over unlicensed spectrum, Wi-Fi expansion into the 5.9 GHz band would add necessary additional spectrum for unlicensed operations and enable the creation of more efficient, larger Wi-Fi broadband channels, thereby relieving congestion in the U-NII bands.

Microsoft also has several efforts underway to connect vehicles to the transportation infrastructure and both to the cloud. Some of these efforts are safety-related and would utilize DSRC spectrum.

Thus, the Commission should use this proceeding to move from answering *whether* the 5.9 GHz band should be shared between DSRC and U-NII devices, to determining *how* best that sharing can take place. In doing so, the Commission should analyze spectrum sharing between safety-of-life vehicle-to-vehicle ("V2V") DSRC applications and Wi-Fi devices, and also between V2V DSRC and unlicensed LTE technologies. A number of non-safety DSRC services exist today and are delivered over commercial licensed broadband networks and unlicensed spectrum. Accordingly, any sharing proposal for the U-NII-4 band should not reduce the utility of the U-NII-3 band for Wi-Fi devices. As the Commission is evaluating the Cisco and Qualcomm proposals, it should try to ensure the harmonization of the technical rules across the U-NII-3 and U-NII-4 bands to the greatest extent possible.

I. INTRODUCTION

Microsoft Corporation ("Microsoft") respectfully submits these comments in response to the Federal Communications Commission's ("FCC" or the "Commission") Public Notice ("PN") inviting interested parties to update and refresh the record on the status of potential sharing solutions between Unlicensed National Information Infrastructure ("U-NII") devices and Dedicated Short Range Communications ("DSRC") operations in the 5.850-5.925 Gigahertz ("5.9 GHz") band.[1] The PN asks for comments on two spectrum sharing proposals, the Qualcomm "re-channelization proposal" and the Cisco "detect and avoid" proposal. After years of discussion, the various 5.9 GHz band interests did not appear to be any closer to reaching a consensus regarding even the potential for sharing. Microsoft supports the Commission's issuing of the PN as a timely and necessary step to move the process forward.

Microsoft filed comments in response to the Commission's 2013 Notice of Proposed Rulemaking ("2013 NPRM") seeking to modify Part 15 Subpart E of its rules governing the operation of U-NII devices. In its comments, Microsoft advocated that the Commission designate the U-NII-4 band for unlicensed use and update and harmonize its technical rules for the existing U-NII bands so as to allow more intensive use of the spectrum while protecting incumbents.[2] By the summer of 2015, however, it was evident that the process for determining whether U-NII devices can share the 5.9 GHz band with DSRC equipment had stalled. Microsoft is appreciative of the subsequent efforts of a number of elected and appointed officials to change the conversation from whether the band should be shared to how best to share the band while protecting DSRC services from harmful interference.

---

[1] *The Commission Seeks to Update and Refresh the Record in the 'Unlicensed National Information Infrastructure (U-NII) Devices in the 5 GHz Band' Proceeding*, ET Docket No. 13-49, Public Notice, FCC 16-68 (2016) ("*5 GHz PN*").

Microsoft supports U-NII devices sharing the 5.9 GHz band with DSRC operations on a secondary basis. Microsoft's customers, whether in an enterprise or as individual consumers, access our cloud-based services over unlicensed devices in the 2.4 GHz ISM band and increasingly in the 5 GHz U-NII bands. According to the Wi-Fi Alliance, more than half of the over 12 billion Wi-Fi certified products that have been shipped to date are dual-band devices operating in both the 2.4 and 5 GHz bands[3]. The 2.4 GHz band is limited to three independent 20 MHz channels. There is considerably more unlicensed spectrum available in the U-NII bands, with the potential of large channel sizes in bands where the IEEE 802.11ac standard can be fully leveraged. The majority of internet traffic is delivered over unlicensed spectrum. As a consequence, even the U-NII bands are becoming saturated at certain times and places as the demand for broadband data, specifically mobile video, continues to grow unabated. Wi-Fi expansion into the 5.9 GHz band would make available additional spectrum for unlicensed operations, allowing for the assembly of larger Wi-Fi channels that span the U-NII-3 and U-NII-4 bands and reducing congestion across the U-NII bands.

To date, the focus on U-NII devices has been on Wi-Fi. Given that technical standards[4] and proprietary technical specifications[5] for unlicensed LTE technologies either exist or will

---

[3] *Wi-Fi® device shipments to surpass 15 billion by end of 2016*, Press Release, Wi-Fi Alliance, Jan. 5, 2016, http://www.wi-fi.org/news-events/newsroom/wi-fi-device-shipments-to-surpass-15-billion-by-end-of-2016.

[4] Licensed Assisted Access (LAA) is a technical standard developed by 3GPP and included in 3GPP Release 13 that allows for the aggregation of licensed and unlicensed spectrum using the LTE air interface for both the control and data channels.

LTE WLAN Aggregation (LWA) is a technical standard developed by 3GPP and included in 3GPP Release 13 that allows of the aggregation of licensed and unlicensed spectrum using the LTE air interface for the control channel and the 802.11 air interface for the data channel (downlink). LWA can be enabled via a software upgrade to LTE and Wi-Fi deployments and requires an upgrade of Wi-Fi infrastructure.

LTE WLAN integration with Internet Protocol security tunnel (LWIP) is a technical standard developed by 3GPP and included in 3GPP Release 13 that allows of the aggregation of licensed and unlicensed spectrum using the LTE air interface for the control channel and the 802.11 air interface for the data channel (downlink). LWIP is designed to work over legacy Wi-Fi infrastructure without requiring any specific changes.

exist in the near future, the Commission needs to understand how certain key operating parameters associated with these technologies, such as the energy detect threshold, maximum transmission burst time (TxOP), and conflicting channel aggregation schemes, may or may not be compatible with DSRC operations. Microsoft is concerned that the added complexity of seeking to also allow unlicensed LTE technologies into the 5.9 GHz band at this time will delay market adoption of Wi-Fi in the band. LTE-U and LAA are yet to demonstrate that either can share 5 GHz spectrum fairly with Wi-Fi, and the implications of having multiple unlicensed technologies in the band have not been taken into account during many of the DSRC/Wi-Fi discussions.

Microsoft also has several efforts underway with auto manufacturers and their suppliers that seek to connect vehicles to the transportation infrastructure, and both to the cloud. Collaborating with IAV Automotive Engineering, Microsoft is exploring new solutions for communication between vehicle and traffic infrastructure to help avoid hazardous situations. Demonstrations have included the "smart traffic light" where cameras installed on traffic lights monitor the traffic situation at an intersection and the collected images are sent to the cloud and evaluated by hazard prediction algorithms based on machine learning. Data from wearable devices worn by pedestrians is also transmitted back to the cloud. If a hazardous situation is identified, the vehicle is informed and would be automatically decelerated.[6]

---

[5] LTE-U is a propriety technical specification for aggregating licensed and unlicensed spectrum, released by the LTE-U Forum, a private industry consortium created in 2014 by Verizon, Qualcomm, Ericsson, Nokia/Alcatel, and Samsung.

Qualcomm and Nokia announced Multefire -- a future standalone LTE small cell based product that will operate exclusively in unlicensed spectrum bands and which will use a proprietary technology based on LAA physical and medium access control layers.

[6] IAV Showcases Vehicle Safety, Connectivity Technologies with Microsoft at SAE 2016 World Congress, Press Release, Iav.com (Mar. 30, 2016), https://www.iav.com/us/press/press-releases/2016/iav-showcases-vehicle-safety-connectivity-technologies-microsoft-sae-2016.

Some have argued that DSRC-based technology has evolved relatively slowly since the Commission initially allocated 75 MHz of spectrum in the 5.9 GHz band for both safety and non-safety services.[7] Microsoft recognizes how ambitious, technically challenging, and important DSRC safety applications are. But we do note that today many of the non-safety intelligent transportation systems applications envisioned to be delivered over DSRC channels are being transmitted over commercial licensed wireless broadband networks and unlicensed spectrum; thus, there is a question of whether some of the non-safety DSRC spectrum can be put to better use. The Commission, therefore, should identify the sharing approach that best minimizes the risk of harmful interference to safety-of-life DSRC operations in the 5.9 GHz band, while at the same time providing meaningful access to more spectrum for U-NII devices.

II. DISCUSSION

A. The Commission Should Focus on DSRC Safety-of-Life Applications

Safety-of-life applications utilizing DSRC channels can involve real-time V2V communications, vehicle-to-infrastructure (V2I) communications, and vehicle-to pedestrian (V2P) communications. These applications have the potential to reduce significantly the incidence and/or severity of certain types of vehicle accidents and the resultant personal injuries, property damages and economic losses. At present, the U.S. Department of Transportation's (USDOT) regulatory focus is on V2V safety applications. Nonetheless, spectrum will be needed to enable all safety application options.

V2V safety applications are cooperative and constitute "a system designed to transmit basic safety information between vehicles to facilitate warnings to drivers concerning impending

[7] Press Release, *Driving Wi-Fi Ahead: the Upper 5 GHz Band*, FCC Commissioners Michael O'Rielly & Jessica Rosenworcel (Feb. 23, 2015), FCC Blog, https://www.fcc.gov/news-events/blog/2015/02/23/driving-wi-fi-ahead-upper-5-ghz-band ("*O'Rielly & Rosenworcel 2015 Blog Post*").

crashes."[8] In real-time, each vehicle must transmit, receive, and analyze data contained in an average 3000 bit Basic Safety Message (BSM), including speed, location, and heading. Each vehicle needs to be able to trust the data provided by the other vehicle. The information on the potential threat or hazard is then presented over the driver/vehicle interface so the driver(s) can take action ahead of time.

V2V safety applications could be used to complement vehicle-resident sensor- or camera-based systems to improve performance such as by reducing false positives, or as a standalone system. When compared on paper to current sensor- and camera-based vehicle safety systems, DSRC's advantages lie with its omnidirectional antenna resulting in a 360 degree field of view rather than being limited to the sensor or camera field-of-view; a greater range (up to 300 meters) by which two or more equipped vehicles can detect each other; and better functionality regardless of weather conditions. The 2014 NHTSA V2V Readiness Report identified three V2V safety applications that cannot be replicated by any current, known vehicle-resident sensor- or camera-based systems.[9] They are: (1) intersection movement assist; (2) left turn assist; and (3) emergency electronic brake lights.[10]

Several technical challenges remain, though, regarding the deployment of V2V technologies. These include the need to ensure a low false positive rate for impending crash alerts in order for drivers to trust the safety applications; addressing congestion mitigation (of the BSM) in all anticipated safety scenarios; the consistency of V2V performance in urban canyons where GPS signals may have difficulty penetrating down to ground level; and the fact that

---

[8] Harding, J., Powell, G., R., Yoon, R., Fikentscher, J., Doyle, C., Sade, D., Lukuc, M., Simons, J., & Wang, J. (2014, August). *Vehicle-to-vehicle communications: Readiness of V2V technology for application.* (Report No. DOT HS 812 014). Washington, DC: National Highway Traffic Safety Administration. ("*NHTSA V2V Readiness Report*") at Executive Summary (xiii).

[9] *NHTSA V2V Readiness Report*, at 26.

[10] *NHTSA V2V Readiness Report*, at 26-27.

NHTSA estimates it will take 37 years "before we would expect the technology to fully penetrate the fleet."[11] Even as USDOT acknowledges, "various aspects of the technology still need further investigation"[12]

One of the challenges is that the Commission adopted technical rules for the DSRC service in the 5.9 GHz band in large part by incorporating by reference the ASTM standard for On Board Units ("OBUs")[13] and Road Side Unit ("RSUs") in 2003.[14] Standards and technology developed for DSRC service well over a decade ago will be locked in and have to be maintained for several decades to come. Much has changed in wireless communications since then.

Additionally, security and privacy considerations were not at the forefront when the concept for ITS using cooperative DSRC for safety applications was first defined in the late 1990s. NHTSA acknowledges both security and privacy considerations will have to be incorporated into DSRC systems. In fact, the system configuration for V2V operations presented in the 2014 NHTSA V2V Readiness Report, requires two radios – "one tuned to channel 172 and dedicated for safety communications and another tuned to channel 174 for security-related comunications."[15] The DSRC system concept called for two radios – one always tuned to V2V communications and one tuned to the control channel (channel 178). Microsoft is not clear whether in the current USDOT formulation if DSRC systems now require the vehicle to have three separate radio transmitters and antennas (plus a GPS antenna).

It is important to note that in the most recent model years, an increasing number of new passenger vehicles are equipped with integral cellular radios. According to one industry analyst,

---

11 *NHTSA V2V Readiness Report*, at 24.

12 *NHTSA V2V Readiness Report*, at Executive Summary - xix.

13 47 CFR 95.1509 - ASTM E2213-03 DSRC Standard.

14 47 CFR 90.379 - ASTM E2213-03 DSRC Standard (ASTM-DSRC Standard).

15 *NHTSA V2V Readiness Report*, at 61.

in the first quarter of 2016, there were more new net automotive subcriptions added for new cellular service than there were new net subscriptions added for new cellular service over phones.[16] The cellular connection for most of these equipped vehicles terminates into a Wi-Fi network within the vehicle. The cellular infrastructure is extensive in most parts of the country. For these reasons, Microsoft believes that non real-time V2I and informational DSRC applications can and should occur over cellular and Wi-Fi networks. State and local DOTs can then target available funds to real-time safety-of-life V2I applications.

B. Qualcomm Re-Channelization Proposal

The Qualcomm 5.9 GHz "Re-channelization" proposal considered previously by the IEEE Tiger Team called for the top 20 or 30 MHz of the 5.9 GHz band (5895-5925 MHz) to be reserved for 2 or 3, 10 MHz-wide high-availability DSRC channels dedicated for real-time safety operations. It would mean that the current channel assigned for V2V communications, channel 172, would be shifted from 5.855-5.865 GHz to 5.895-5.905 GHz or 5.905-5.915 GHz depending on the number of reserved channels.[17]

U-NII devices, including those using Wi-Fi, would not be able to operate in this protected frequency range. The lower 45 MHz of the band would be shared between unlicensed operations and what Qualcomm refers to as non-safety-of-life DSRC applications. These non-safety-of-life operations would operate on 20 MHz-wide channels and share these channels with unlicensed devices on a non-interfering basis. Qualcomm argues that the 20 MHz channel width allows for

---

[16] Mobile Market Update - Q1 2016, ChetanSharma.com (last accessed July 6, 2016), http://www.chetansharma.com/usmarketupdateq12016.htm.

[17] *Final Report of the DSRC Coexistence Tiger Team*, IEEE P802.11 Wireless LANs, Mar. 9, 2015, https://mentor.ieee.org/802.11/dcn/15/11-15-0347-00-0reg-final-report-of-dsrc-coexistence-tiger-team-clean.pdf.

the more efficient detection of the DSRC signals. When initially proposed, Qualcomm believed that the sharing solution(s) would be developed within the IEEE.

Qualcomm's proposal would lead to three additional 20 MHz channels; two additional 40 MHz channels; one additional 80 MHz channel; and most importantly, one additional 160 MHz channel available for Wi-Fi devices to access on a shared basis. These channels would be available for U-NII devices all of the time – everywhere – inside and outside. If adopted, Qualcomm's proposal would increase the amount of spectrum available for unlicensed access and allow U-NII devices operating in the U-NII-3 and U-NII-4 bands to take advantage of the larger 802.11ac channel sizes.

Based on the record developed in this PN, the Commission will determine the minimum number of channels that are required for safety-of-life DSRC applications and if additional spectrum is required to ensure these safety-of-life DSRC applications are protected from harmful interference within the band and from neighboring bands. If the Commission determines that more than 30 MHz needs to be dedicated for real-time safety-of-life V2V and V2I DSRC services (and to protect DSRC equipment from interference), then one 40 MHz, one 80 MHz, and one 160 MHz channel would no longer be available for Wi-Fi use on a secondary basis. The total increase in spectrum available for unlicensed use on a shared basis in the 5.9 GHz at best would be limited to a gain of two, 20 MHz channels.

As the Commission is reviewing the Qualcomm proposal, it should keep in mind its statement made in the 5 GHz Notice of Proposed Rulemaking -- that if it adopted its proposal for U-NII-3 rules to be applied to the upper adjacent 25 megahertz band segment at 5.825-5.85 GHz, "…we believe that the same framework and technical requirements specified in Section 15.407

should apply across the expanded U-NII-3 and the U-NII-4 bands."[18] Microsoft considers the Commission's actions to harmonize the technical rules across U-NII bands to the greatest extent possible as critical to the success of Commission's 5 GHz First R&O and the increase in the commercial use of the bands.

C. Cisco Detect and Avoid Proposal

Under the Cisco proposal of December 23, 2015,[19] if a DSRC beacon is detected, U-NII devices would not only have to vacate the 75 MHz in the U-NII-4 band for one second, U-NII devices would also have to vacate the top 25 MHz in the U-NII-3 band for the same period of time.

This would effectively undo the Commission's action in its 5 GHz First Report and Order when it added 25 MHz to the U-NII-3 band -- which the automakers opposed. Eliminating the 25 MHz from the U-NII-3 band makes the proposal unacceptable to Microsoft. Alternatively, if Cisco and those supporting the Cisco proposal believe that a lower V2V communications channel requires an additional spectral separation from Wi-Fi, despite what the Commission determined in it 5 GHz First Report and Order and subsequent 5 GHz Memorandum Opinion and Order,[20] it could modify its proposal by eliminating at least three non-safety-of-life DSRC channels and shifting the V2V safety application to a higher channel.

Assuming only V2V communications, U-NII-4 devices could conceivably operate under harmonized U-NII-3 technical rules where there are no DSRC-equipped motor vehicles in operation. Microsoft imagines these locations would be indoors within enterprises, private

---

[18] *Ibid* at 97.

[19] *Cisco ex parte filing in Revision of Part 15 of the Commission's Rules to Permit Unlicensed National Information Infrastructure (U-NII) Devices in the 5 GHz Band*, ET Docket No. 13-49, December 23, 2015.

[20] *In the Matter of Revision of Part 15 of the Commission's Rules to Permit Unlicensed National Information Infrastructure (U-NII) Devices in the 5 GHz Band*, ET Docket No. 13-49, Memorandum Order and Opinion, Adopted March 1, 2016.

homes, apartment buildings, and commercial buildings that are a certain distance offset from the nearest road edge and/or are at certain height above the road surface. Over time,Microsoft would not expect U-NII devices to be operating in the 5.9 GHz band on ground level (and at some distance above).

With respect to V2I, the antenna height of roadside units can reach up to 15 meters.[21] Such placement would impact nearby indoor use on higher floors, particularly in urban areas, if the units were permitted to operate without highly directional antennas. In some connected car scenarios, such as the one IAV Automotive and Microsoft collaborated on, there is intelligence embedded in the traffic light. A traffic light may or may not be considered a roadside unit, but it is definitely part of the infrastructure. For this reason, the Commission might consider capping the maximum height above average terrain for all RSUs to the height of the average traffic light – except in areas with low population density.

III. CONCLUSION

Microsoft supports the Commission's efforts to refresh the record from its 2013 rulemaking on unlicensed device sharing with DSRC in the the 5.9 GHz band and to begin testing unlicensed device prototypes to find new and more creative uses for that spectrum.

Respectfully submitted,

Paula Boyd
Director of Government Relations and Regulatory Affairs

Michael Daum
Technology Policy Strategist

Microsoft Corporation
901 K Street NW, 11th Floor

[21] 47 CFR 90.377 (b), n.1.

Washington, DC 20001

Of Counsel:

Lawrence R. Krevor
James F. Ianelli
Perkins Coie, LLP
700 13th Street, NW
Washington, DC 20005